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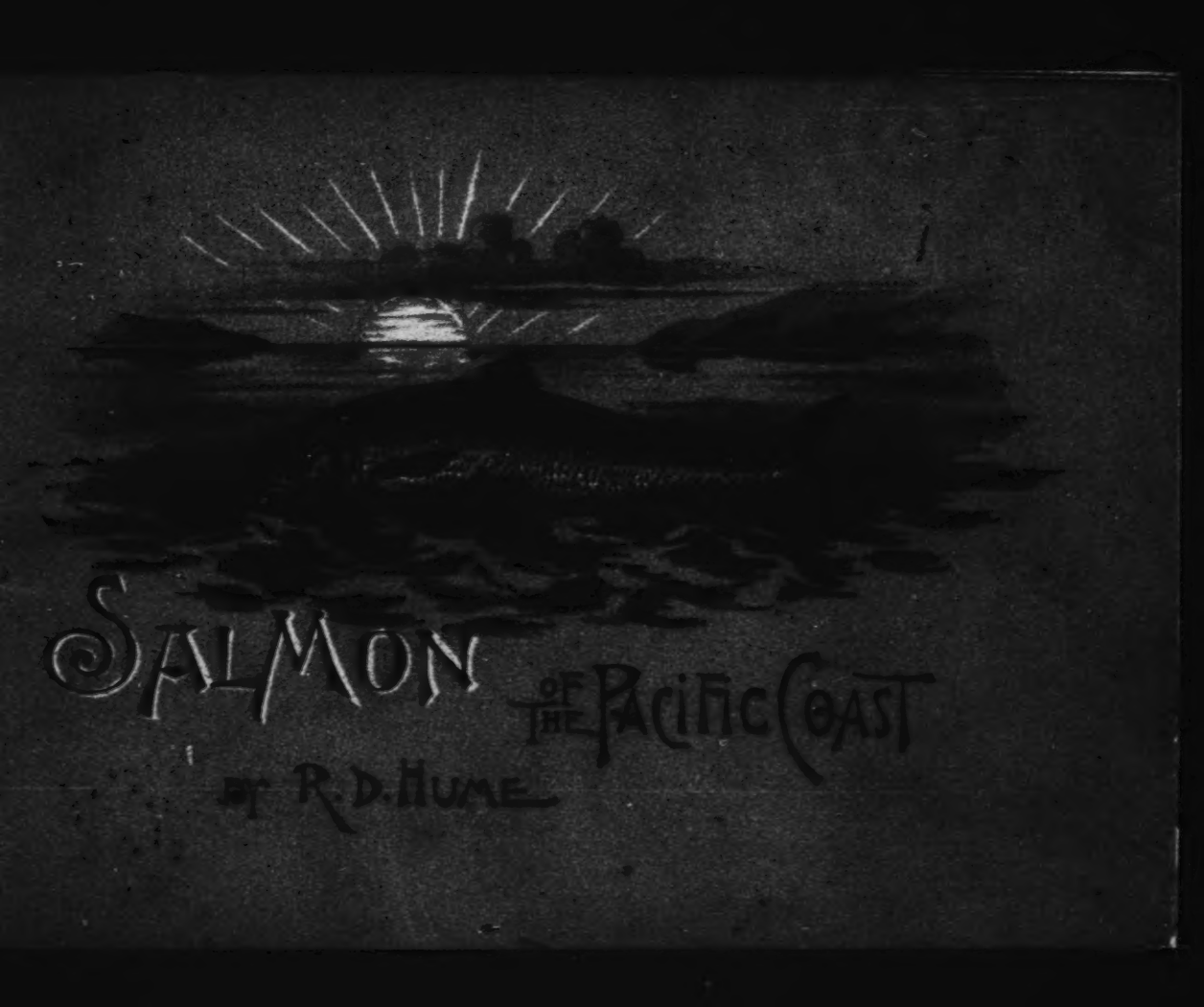

SALMON
OF THE PACIFIC COAST
BY R. D. HUME

SALMON OF THE PACIFIC COAST

— BY —

R. D. HUME,

With engravings, showing the apparatus used for their artificial propogation, and the operations of Salmon Fishing and Canning as conducted at Gold Beach, Curry County, Oregon, U. S. A.

1893.

SH348
H8

Yours Truly R S Hume

—TO—

THOMAS L. PELLING, Esq.

By whose efforts the Canning Industry has received its greatest impulse.

This little work is respectfully dedicated

—BY—

THE AUTHOR.

PREFACE.

To call the attention of both producer and consumer to the danger of the total extinction of this most valuable of food fishes, and provide a simple method for their preservation is the object of this *Little Work.*

THE SALMON OF THE PACIFIC COAST.

I. Their Influence upon the Industries and Share in the Development of the Northwest.

By R. D HUME.

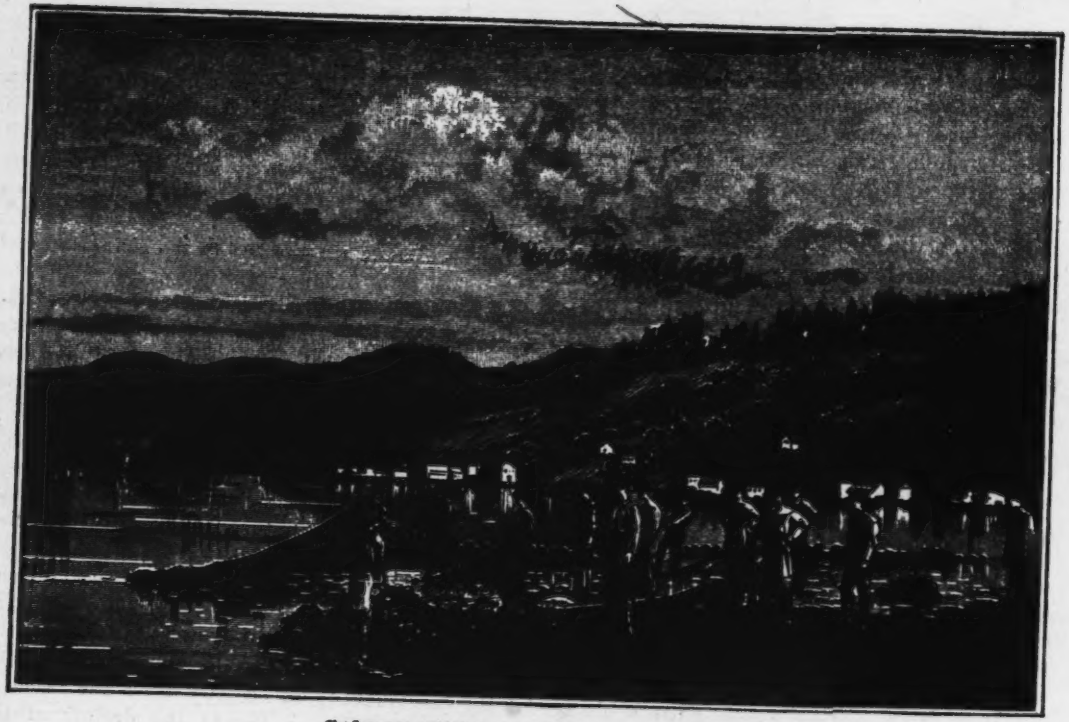
TO GIVE the reader a clear idea of the salmon industry of the Pacific Coast, and the influence it has had in the development of the Northwest, it will be necessary to give a brief history of the salmon canning business, the advent of which practically begins the salmon fishing era of the Pacific Coast; although prior to that time the taking of salmon had been done to considerable extent to supply the market with fresh fish, and a moderate quantity had been salted. But in comparison with the canning business, the quantity taken for these purposes was of little importance.

The business of canning salmon on the Pacific Coast was begun in the spring of 1864, at the town of Washington, Yolo county, California, on the banks of the Sacramento river, opposite the foot of K street, Sacramento city, by the firm of Hapgood, Hume & Co., the firm consisting of Andrew S. Hapgood, George W. and William Hume, with the writer as "sub" under small pay, but with large expectations of a partnership interest, to be realized whenever the business should prove the success anticipated. The pack of the first year amounted to about 2,000 cases, and the trials and difficulties attending their production are almost

impossible to realize and describe, after the lapse of twenty-nine years, considering the improved methods of to-day. The business being in the form of an experiment, and the tools used being of the most primitive character, made the work necessarily slow and difficult, and the product defective. As I cast my mind backward to those early days of the business, I wonder that it was not given up in despair. At least fifty per cent of the product spoiled at the cannery from the effect of defective work as we had at that time no process for testing for leaks, as at present; consequently all leaky tins were lost; and there were many also in addition to those so imperfectly made that they burst in cooking. To these troubles were added the difficulty of disposing of that part of the product that was good, the article being new to the merchants of San Francisco. they would have nothing to do with it for a long time, and in the interim the firm were very much discouraged and were on the point of breaking up. At that time a few hundred dollars would have purchased all their interests in the business. Just at the darkest time, however, a merchant of San Francisco advanced shipping charges on the lot and found a market at good prices, which awakened a new enthusiasm, and the business went ahead again.

In the next two years the amount packed per annum was not much increased, on account of the scarcity of salmon in the Sacramento, and in the spring of 1866 William Hume went to the Columbia to see what could be done. Upon his return with favorable reports, G.W. Hume also went to the Columbia, for the purpose of selecting a site and building a cannery and other necessary buildings, that should be ready for the reception of the others, who went there some time in October of that year. The point selected by him was at Eagle Cliff in Wahkiakum county, Washington, and part of the cannery now owned and operated there by Wm. Hume is the original building erected by him. During the winter of 1866-67 we put our machines in order and made the nets and cans for the spring season of 1867, at which time we packed 4,000 cases of 48 cans each.

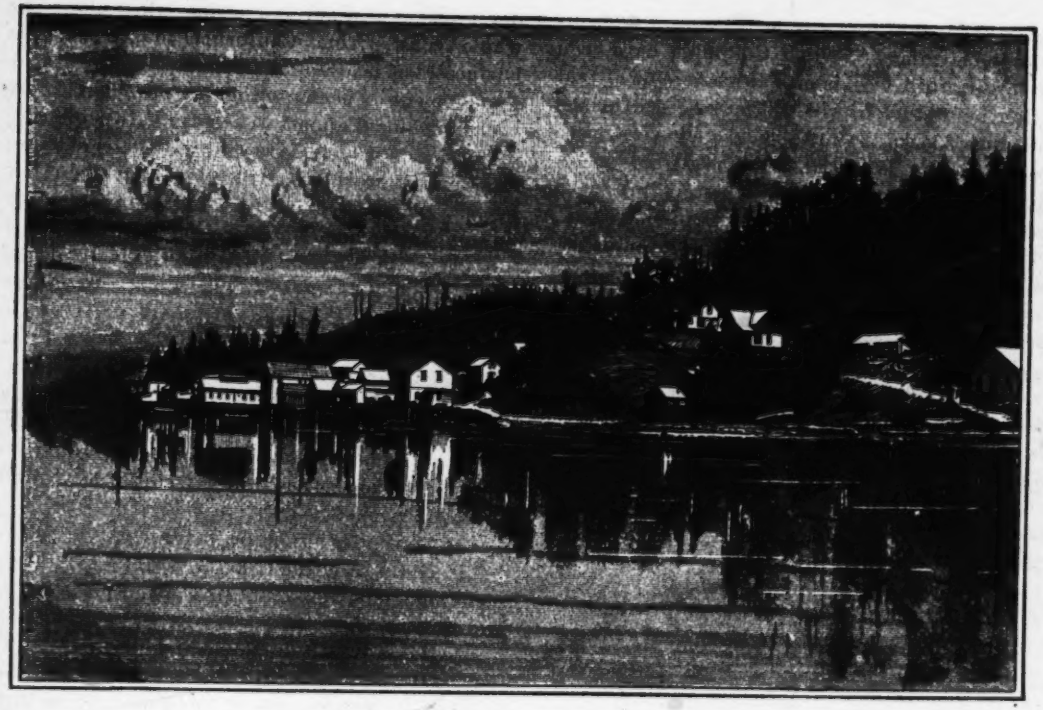
At the time of our arrival there was but little business done on the Columbia river below Portland, and in fact Portland itself was a small town, all of the business houses being located on Front and First streets. The business of the lower Columbia river was done at St. Helens, Rainier, Oak



Salmon Fishing at Rogue River.

Point, Cathalamet and Astoria, which town boasted one small wharf, and that was in a chronic state of dilapidation. The steamboat service was performed by a small side wheel steamer, called the John H. Couch, which made tri-weekly trips between Portland and Astoria with the mails, touching at each of the points mentioned above. Sometimes she would get a schooner to tow, and then the routine was broken, as it would take her two days to get from Astoria to Portland. At this date her passenger list, at times, would consist of a solitary soldier from Fort Stevens, who had been discharged or granted a furlough; and the freight, a case of condemned cartridges from the same place. At this time the business of the lower Columbia cut but a small figure—a wheezy old mill at Astoria and a dilapidated affair of the same kind at each of the other places on the Columbia, except Cathalamet, which had nothing in the way of manufactures, comprised all there was to furnish a livlihood for the laborers of that section, except that furnished by the few engaged in salting salmon, and that work was mostly done by Indians.

In a lapse of ten years, what a change! Portland has by this time become a city of importance, and Astoria has stretched itself along three miles of water front; while instead of four small landings along the main Columbia, between Astoria and Portland the number has increased to more than forty, and instead of one small steamer making tri-weekly trips, we have four elegant steamers running between these places daily, besides about a dozen running in the fish carrying trade for the use of the canneries, and in place of a product of 4,000 cases of 48 tins each, we have a product of 450,000 cases, of the same number of tins, and we have our wheezy and dilapidated old mills running night and day to supply the demand for lumber to build new canneries, and where desolation ruled before we find signs of the greatest activity. We find all trades and professions plunging to get a whack at this new El Dorado, all seeking a fortune to be made from the capture of the scaly beauties. What a mine of wealth, that even all who might plunge might be enriched. But all good things which nature has furnished have a capacity beyond which they cannot be strained, and the year 1883 brings Columbia its maximum, when the vast quantity of 630,000 cases was reached; and from this time begins the decline of the



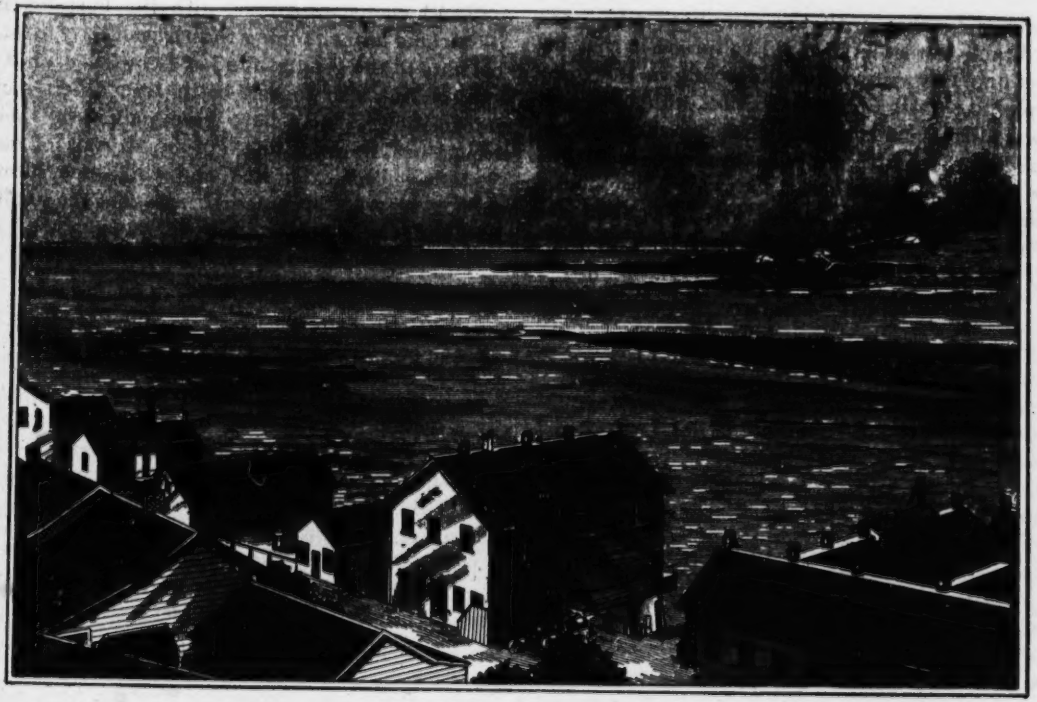
Gold Beach Cannery from the Sea.

salmon product of that wonderful stream. Meanwhile the streams of British Columbia have been developed, until 1882 marks to the credit of that section a product of 255,000 cases, and at the same time Alaska began to make a showing, with a pack of upwards of 20,000 cases, which gradually increased until 1892, when it produced more salmon in cases than the Columbia river, and its output, added to that of British Columbia, the Columbia river and other rivers of Oregon, brings the total pack of 1892 up to 1,323,000 cases, which represents in value, approximately $6,549,000.

What a contrast between the years 1867 and 1892, as regards the industry. At the first date one cannery, with its small product, having great difficulty in obtaining sufficient employees to prosecute the business, while in 1892, in addition to the large number of canneries in British Columbia and on the Columbia river, which were employing thousands of people, there was not a stream putting into the ocean along the Oregon and California coast, which can be entered even by the lightest draught vessels, that has not one or more canneries located on its banks, forming a nucleus from which radiate the development of other industries; while along the whole coast, from California to Alaska, the business has become an important factor in the development of such sections as have heretofore been considered almost inaccessible, by offering inducements which have sent the pioneers ahead to begin the work of civilization, that in a few years will furnish, in addition to the large number now engaged, homes and employment to a vast number of people, if rightly fostered, without the stimulating influence of which these sections would remain desolute for centuries.

The salmon industry of the Pacific coast has furnished lucrative employment to thousands, and has been both directly and indirectly the means by which very many have made fortunes, and who without its benefits would perhaps find themselves out of employment and lighter in pocket.

In view of the great importance of this industry, it would seem the imperative duty of all engaged or in anywise interested in the business to protect and preserve, so far as is possible, the source from which the essential factor springs, namely, the salmon of the Pacific coast; and the best efforts of the minds of those who are in any



Looking to the Sea.

manner familiar with the conditions which are favorable to that end should be turned in that direction. The writer, firmly believing in the principles set forth in this section, although well aware that there is much yet for him to learn regarding the matter, proposes to give to the public as the result of the observations of a lifetime, a series of articles, wherein will be contained a history of the experiments made and experience gained by constant contact with the business in its various forms, hoping thereby not only to add his mite to the general fund of knowledge of the subject, but also to call forth from others such information as may have been gained by their experience, in order that, ere the streams of our State have been exhausted, and while such information may be of practical use, that the public may receive the benefit.

2. Their Value as a Food Product and the Proper Methods for their Protection.

FOR many years prior to the advent of salmon canning on the Pacific Coast, owing to the scarcity of these fish in other parts of the civilized world, salmon had become a luxury of which none but the wealthy could partake, and the writer, when a small boy, heard two of the wealthiest citizens of his native town (Augusta, on the Kennebec river, in the State of Maine) argue for half an hour as to how a salmon of ten pounds weight should be divided so that each should get a fair proportion of the fat, and which should have the head part; and finally, after appealing to the large crowd of bystanders for their opinions regarding the question, at length settled the matter by cutting the fish on an angle, from belly to back, so as to give the one with the tail portion a fair share of the belly; and then paid $1 per pound for their portion, and went home with smiles on their faces and eyes glistening in anticipation of the glorious feast they were to have on the morrow.

At this time, which was about the year 1853, the catching of a salmon at this point on the Kennebec river was of rare occurrence, usually the catch for a season being three or four, and a half dozen being a large take for the year. At this time the principal supply of salmon for the markets of the United States was procured from the Penobscot river in Maine and the waters of the British provinces, namely: Mirimichi river, and the rivers putting into the bay of Chaleur; and these could be obtained only in limited quantities, and at a great expense to the consumer. Up to the age of eighteen, the time the writer left home for the Pacific Coast, although some of his family were engaged in the fishing business, it had never been his fortune to taste salmon but once, and it is doubtful if but few in that State of his age had ever seen one. What a blessing came to the poor

with the establishment of the salmon canneries, and with their progression, an increasing benefit, to that extent that in 1892, allowing one can for two persons, which is amply sufficient, one hundred and thirty-five millions of poor people could enjoy, once in a year, such a luxury—and considering the amount of nutrition and ability to satisfy the appetite, at less than the price of any kind of flesh food.

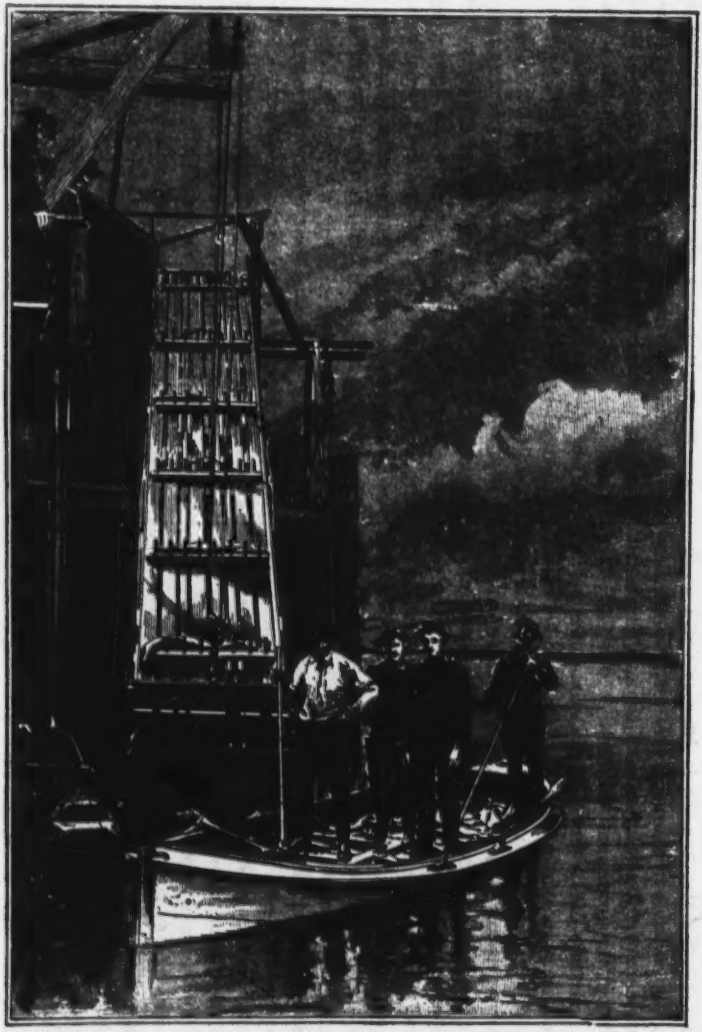
In the early days of the salmon business South America and Australia furnished the consumers for the product, but as the supply increased a market in England was sought, which at first did not take kindly to the American product; but by the persistent efforts of a few of the principal dealers in food products (one of the most active of which was the firm of Pelling, Stanley & Co., of Liverpool, now one of the largest distributors of canned salmon in the world) the article became known, and the people of Great Britain in a short time became the principal consumers. A great deal of the prosperity enjoyed by the business is due to the efforts of these gentlemen, who were pushing, progressive people, their perceptions being alive to the fact that in this new product was embodied a nutritious food supply for the masses at the lowest possible cost, as compared with the products of other descriptions. I well remember the story of Mr. Pelling in regard to his experience with the first lot of 500 cases of salmon that he had purchased—of his efforts to get his customers to take a few cases for trial, and his arguments to them that canned salmon were to furnish Great Britain a cheap and nourishing food for her laboring population—his failures to get buyers to take hold of the new goods, and his daily walks around the pile of cases to see if any had been disposed of; his discouragement when observing that, though a long time had elapsed, the pile seemed as large as ever. But after a time by patient and continuous effort, allied to the fact that the article had the merit claimed, brought the consumptive demand of Great Britain up to 450,000 cases per annum. Not much effort was made to create a demand in the United States until the increase of the pack had overloaded the other markets, at which time a new factor came upon the scene, in the person of J. K. Armsby of Chicago, who now occupies much the same relative position in the United States, as regards the distribution of canned salmon, as does Pelling, Stanley & Co., of Liverpool to the same line in the English

market. To Mr. Armsby is due in a great measure the rapid extension of the demand for this article in the United States, although there are many other prominent dealers.

In view of the fact that the salmon supply is a matter which, as a figure in the food question of so many millions, is of much importance, as well as being the source of so much wealth to the Pacific Coast, it certainly would seem strange if the people of this country did not feel disposed to foster both the business and the source from which it derives its life. It is the desire of the writer to present such facts for the consideration of his readers as will shed some light upon a question which, although it has been treated in various forms by very able writers for more than forty years past, still, in view of the success made by the operation of any plans laid down in the various works upon the subject, or benefits derived from legislation upon the matter, seems yet to the great majority as being in an experimental state. The first point to consider in this connection is the question, What were the conditions of the various streams when the salmon supply was most plentiful? And it is easily answered: There is no question but salmon were most plentiful before civilization had begun its work, and when dams, traps and other obstructions and hydraulic mines were unknown, when the sources of the river were unsettled and undefiled by the sewerage of the cities, the forests at the head waters still untouched by man, and the country yet in its natural state.

The effect of a change of conditions can be best indicated by a description of the situation on a few of the salmon streams that have been either wholly exhausted or rendered practically useless for commercial purposes in this branch of industry, and those that are rapidly approaching that condition.

Taking the Kennebec river, which was a fine salmon stream at the early settlement of the country, and reflecting upon the possibility of the supply being maintained under the conditions which were in effect in the year 1853, the mind is easily satisfied as to the causes which led to the almost total extinction of these fish. By this time cities were located within a few miles of each other all along the banks, discharging their sewerage and waste from gas and dye works into the stream, while at Augusta was situated a dam which was impassible for any sort of fish, no



Delivering Salmon at Cannery for Canning Purposes.

provision for a fish ladder having been made, until through the exertions of Seth Green (who has been justly termed the father of fish culture in America) about 1857 one was constructed, but was soon allowed to get out of repair, and was of no practical use. There were also a large number of sawmills delivering their sawdust and other waste into the river, the timber was being rapidly removed from the tributaries which formed the headwaters and spawning grounds of the stream, while the lower part of the river, in Merry Meeting bay and other favorable locations, was lined with traps to such an extent as to render the escape of a fish almost an impossibilty, and only a very narrow channel was left for the passage of steamboats, and this running in such a serpentine course as to require a skillful pilot to work the vessel through.

The Sacramento river, prior to the introduction of hydraulic mining in 1853 was, during the running season, so plentifully stocked with salmon that no use could be made of but a moiety of the supply, and we have an illustration of the destructive force of this new agent when we consider the fact that eleven years after its introduction the Sacramento river was practically rendered useless for commercial purposes as a salmon stream.

The Klamath river furnishes another illustration of the destructive action of hydraulic mining upon the salmon streams of the coast. In 1850 in this river during the running seasons, salmon were so plentiful, according to the reports of the early settlers, that in fording the stream it was with difficulty that they could induce their horses to make the attempt, on account of the river being alive with the finny tribe. At the present time the main run, which were the spring salmon, are practically extinct, not enough being taken to warrant the prosecution of business in any form. The river has remained in a primitive state, with the exception of the influence which mining has had, no salmon of the spring run having been taken except a few by Indians, as a reservation by the government has been maintained, until within a few years, and no fishing has been allowed on the lower river by white men; and yet the spring run has almost disappeared, and the fall run reduced to very small proportions, the pack never exceeding 6,000 cases, and in 1892 the river producing only 1,047 cases.

The next and most important river on the coast to receive consideration is the Columbia, and

this, though not yet exhausted, has shrunken its output since 1883, in the number of cases produced, more than one-third, and according to good authorities the product of 1892 was but little more than 150,000 cases of true adult Chinook salmon, the balance of the pack being steel-heads, blue-backs, and a small salmon of a variety which will later receive attention. This, if true, would show a fearful decrease in the past nine years, amounting to more than three quarters of the supply of the quality packed when at its best; and from both packers and fishermen comes the cry that, although the demand for the article is good, they are unable to make living profits from the prosecution of the business. A contemplation of this proposition leads one to inquire what have been the conditions that have brought about such a result, when since 1883 the number of canneries on that river have decreased considerably, and during the time a hatchery has been in operation, which has turned out millions of young salmon every year.

Prior to 1879 traps and fish wheels cut a small figure in the methods of taking salmon on the Columbia river, the few traps in operation being mostly in the vicinity of Oak Point, the lower river about Astoria being free from their influence. Since 1883, however, the number of traps at Astoria and fish wheels on the upper river have rapidly increased, with a corresponding decrease in both the quality and quantity of the salmon packed on that stream, as well as a rapid falling off of the profits of the business. The question will naturally be asked, in view of the difficulties surrounding the proposition, can the supply be maintained in such a manner as to protect the industry? This I answer in the affirmative, if the operations toward stocking the rivers are maintained in a proper manner, and the right sort of legislation is had upon the question of taking the product of the rivers.

While I quite agree with my contemporaries upon many of the questions regarding the varieties, culture and habits of salmon, there are some of the most vital points upon which I shall be compelled to take issue with them, the first of which is the question whether all the small salmon taken by the traps and fish wheels are a distinct species; the second being whether they are all male salmon and all perish after making the first trip to the spawning grounds; and the third, do all adult salmon die after spawning?

As a brief answer to these questions, which will be treated more fully in a later article, I will say that outside of the variety known as blue-back, which is a distinct species of salmon, and the young steel-heads, which are quite numerous, the grown members of whose family are a valuable adjunct to food supply, that the great bulk of small salmon, as observed by me, are the young of the true Chinook salmon; and I deny that it is a fact, as is claimed by some very intelligent gentlemen, that all young salmon taken by the traps and fish wheels are males, and consequently might as well be caught, but will state that in the female grilse at the age of two years not even a sign of eggs can be found, and that they could be easily mistaken by a careless observer for males, unless the male was very near the spawning time, when its seed would have developed in such a manner as to make such a mistake impossible. Neither can I agree with the proposition that, conceding they were all males, that all perish after having made their first journey to the spawning grounds; and I should feel obliged to any reliable gentleman who has seen any number of the true Chinook salmon, in their two year old form, without regard to sex, lying dead about the head waters of the Columbia or any other river on the Coast, who would communicate the fact, as so far I have been unable to obtain information of that kind. While it is without doubt that in streams of great length the adult salmon die after spawning, it is also a fact that in the shorter streams very many return to the sea after having done so, and it is unreasonable to suppose that the Creator has so deviated from the law which He has established with all else in nature as to have created salmon with such an excess of the male species, and that millions could be thus cut off prior to maturity without damage to the perpetuation of the whole class. In view of this phase of the question, what other remedy can be suggested than that during the running season of the salmon grilse traps and wheels should either suspend operations or make some arrangement whereby the small salmon may escape—a provision for which in their construction, could be easily made. In no river having a spring run should be taken any variety of salmon of less than five pound in weight. It would seem an unprofitable proposition to undertake to keep up the supply with hatcheries, if their output is to be taken in two-year-old form, thereby losing at least four-fifths of the weight which

might be gained in another two years of growth. A strict observance of this rule, together with a reasonable quantity from the hatcheries, would keep up the supply at least, and would probably increase it.

Another very important factor in the preservation of the species would be the establishment of stations on the lower river, where, after the spawn had been taken and cared for at the hatcheries on the natural spawning grounds until the eye spots were formed, and the eggs able to bear transportation, where the final hatching and turning loose could be done. In my estimation, ten thousand young fish turned out in a healthy state, at a time when they are able to take care of themselves in the lower river, just above the influence of brackish water, are of more value to the river than one hundred thousand turned out at the head waters, for the reason that at the spawning and hatching time trout, and fish of all kinds which prey upon the eggs and young, congregate at the headwaters and gobble up both eggs and young fish by thousands. The turning out of large numbers in a small stream attract their enemies of all kinds, beside giving the young fish an insufficient supply of food, from which lack many perish from starvation. By following this plan the young salmon would be where their enemies would not be able to find them, as well as being able to obtain the food supply of the whole stream.

A careful attention on the part of the fish commission of the State regarding obstructions which prevent the salmon from reaching the natural spawning grounds, such as dams and traps, placed entirely across the streams, would be a powerful factor toward the preservation of the species; and the passage of a law which would make it a crime for taking or having a gravid or spawning salmon in possession, except for spawning purposes, with the assistance of the other factors mentioned above, assisted by the operation of such hatcheries as the importance of the business seems to justify, would enable the industry to remain as permanent a branch as that of agriculture.

Professor Baird often said that "one acre of water was worth seven acres of land, if properly cultivated," but I am convinced that the Professor erred only in this, that I believe one acre of the waters of any salmon stream in Oregon, if judiciously cultivated under favorable circumstances,

and if not paralyzed by ignorant or vicious legislation, is worth more as a medium for the product of a food supply than forty acres of the best land in the State. The fact, however, that there are many different streams which produce salmon that have their runs at different times in the year, and also that the same river may afford runs of different kinds at various times in the year, makes any laws heretofore passed, which apply to the seasons they have sought to close, inapplicable to the necessities of the case, and productive of more harm than good. In view of this position of affairs I would submit the following plan to my readers, which to my mind, in addition to the preceding sections, seems the only way of taking a grasp of the whole question with any certainty of realizing a benefit:

Let an act be passed by the legislature which shall provide for the appointment of a Chief Fish Warden for the State, who shall have deputies in every county, whose duty it shall be to take note of the different runs of Salmon and Trout in his district, and report the same to the head of his department; and an act which shall provide that in parts of such streams, wherein lie the natural spawning beds, no fishing for salmon or trout shall be done for one month prior to, nor at any time during, the spawning time of the different runs, and making it the duty of the fish warden to close such portions of the stream by posting notices at various stations along the banks, denoting such portions as shall remain closed to fishing, and also to publish notices in the nearest newspaper to the same effect, and any violation to be punished by a heavy penalty. Also an act providing that no salmon of any variety in any of the rivers of the State of Oregon should be taken by traps, fish wheels or seines, of less than five pounds weight.

I will add that unless some such steps are taken, in less than ten years the packing of salmon on the Columbia river will have become impossible as a business proposition, and in much less time the truth of this proposition will become apparent. But by the passage of the laws mentioned, and the adoption of the suggestions herein contained, the salmon supply would be kept up without interfering with any other branch of industry, for reasons that will appear in future treatment of other branches of the salmon question.

3. A Short Treatise upon the Commercial Varieties and their Habits.

THE varieties of the genus salmo are classed by many ichthyologists as being of fifty-two distinct species, which includes all varieties of the trout family, but owing to the slight difference in the appearance of many which are named, there has been a great diversity of opinion in regard to the question. The fact that in rivers which enter the sea within a few miles of each other, as well as the different tributaries of the same river, the fish will have local characteristics which enable those who are familiar with the various streams to distinguish to which river or tributary they belong, should cause little surprise that there was some confusion in regard to the question. The character of the water, alkaline or otherwise, temperature, color of the gravel which forms the spawning beds, color of the timber, light and shade at the headwaters —all have their influence in the marking and coloring of these fish. A consideration of the character and habits of the whole family would, however, call for more ability and occupy more space than is alloted to the writer, therefore only those varieties used for the purpose of canning will receive attention.

First, and most valuable, are the Salmo Quinnat, or Chinook salmon, which are to be found at different times, according to locality, between the months of March and October, in varying quantities, in nearly all the rivers of the Coast, from the Sacramento to Alaska, and are known at the latter place by the name of King salmon. The duration of their run also varies with the locality, and their quality depends upon the season in which they are taken, those of the spring and early summer months being so much superior in fatness and flavor as hardly to be recognized as belonging to the same species, when prepared for the table. Certain conditions seem

necessary to produce a spring run of Chinook salmon, among which is that the river must take its rise in the mountains of the interior which are clad in everlasting snow, the melting of which produces an early spring freshet, the fresh waters extending a long distance into the sea, producing a growth of feed that is favorable to their reaching a high state of development, thus preparing them for the long and arduous journey they must make in order to reach the spawning grounds. The only rivers of the Pacific Coast which seem to furnish the conditions necessary for a spring run of salmon are the Columbia, Sacramento, Rogue and Klammath.

In these rivers Chinook salmon begin to run during the month of March, and a few have been taken even earlier, but are limited to small quantities until about the middle of April, and generally continue until about the first of August, although some seasons may cut off a few days earlier or continue a short time longer. The different runs, according to the date of their arrival, have their particular objective point, those coming earliest making for the extreme headwaters, while, according to the order of their coming, later arrivals fall into tributaries less and less remote from the sea, until the last to come spawn in the main river.

Those which reach the headwaters spawn during the month of August, and later runs in their order during September and October. It seems necessary for the maturing of the eggs of this species that the fish should remain in the fresh water about four months, and the writer will state that for years past it has been the custom at his hatching pond to hold salmon nearly that length of time, to let the fish ripen for spawning, even after they had been held in the river for some time prior to being placed in the ponds, and this without supplying them with any sort of food, which seems to settle the question regarding their taking food, while they are in fresh water for the purpose of propagation. However, this is not the case with the Silversides, as they will, while in the bays, take a hook readily. The Chinook salmon of the streams which take their rise in the Coast Range of Oregon, and those called King salmon in British Columbia and Alaska, are (making due allowance for the local influence of the streams wherein they are caught) identical in character. The running time of this branch of the family also varies with different streams,

those on the Oregon coast coming in during August and September, but not ascending above tide water until after the fall rains of the early part of November, and spawning from the first of December to the 15th of January; while on the coast of California they are considerably later, and in Alaska much earlier, in some of the streams running as early as June and spawning in July.

The most important of all, except the spring Chinook, as regards quantity, and by many considered superior in quality to all except them, is the Blue-back, as it is called on the Columbia river, Saw quai in British Columbia, and Red salmon in Alaska, where they are found in large quantities. The quality of these fish also depends largely upon the locality where they are found, the Columbia, Frazer, Skeena and Nass rivers producing the best. This species of salmon seems to seek, for spawning purposes, those rivers that are formed by the outflow of lakes to which they can have access, and their spawning time is from July to October, according to locality. The adult salmon of this species weighs from six to eight pounds, and their flesh is the richest red color of any variety used for canning purposes.

The Silversides of the Oregon coast, or Silver salmon as called in Alaska, are an excellent fish for the table when fresh, but on account of their pale color are not so highly esteemed in the markets when canned, as the public taste has been educated to expect a bright color as evidence of quality; but there are many engaged in the business who prefer these to the red salmon of Alaska for their eating. The greater portion of these fish that find a market are packed on the coast of Oregon, and their run begins about the middle of September and lasts until the early rains, when they leave the bays for the spawning grounds, spawning from the middle of December until February, although both running and spawning seasons vary slightly in the different streams.

The Steel Head, or as it is variously called, Sea Trout, Bull Trout or Salmo Trutta, ranges in weight, when mature, from three to twenty pounds, although some attain even a larger size, and as regards quality are about on an equality with the Silversides. This species may be found in the rivers at almost any season of the year, but their principal running time is from January to March, and their spawning season in April and May. After spawning they return to the sea with

Dressing and Cleaning Department.

small loss in numbers from the effect of propagation. Having noted the different varieties used for canning and the various seasons in which they make their appearance, we will now escort a couple of the most royal of all classes, the spring Chinook, to the headwaters, and endeavor to trace out the object and result of their journey, as well as some of the difficulties which they encounter. These fish make their appearance outside the bar for several weeks prior to entering the rivers, drawing nearer as the time progresses, as it seems for the purpose of gradually becoming seasoned to the change from salt to fresh water, which would seem necessary from the fact that a salmon taken from fresh water and placed at once in sea water will die immediately, and it is reasonable to suppose that the reverse would have the same effect. After having entered the fresh water portion of the stream, they move up the lower portion of the river at a speed ranging from fifteen to forty miles per day, according to the nature of the stream, but as they ascend the more rapid portions at the headwaters their rate of speed becomes greatly diminished.

After having arrived at the spawning grounds they settle in some deep, shady pool, just below a wide shallow riffle or gravel bar, where the water is from one to two feet in depth, and runs with a moderate speed and a straight current from bank to bank, without eddies or obstructions, which cause varying currents. There they remain, comparatively quiet, until within about two or three weeks of spawning time, when the male moves up to the riffle and begins the formation of the redd, or spawning bed. This he does by rooting with his nose and pushing away the gravel with his powerful tail until he has made a hole or pit several feet in depth. In his efforts he often makes a sorry sight of himself, by having worn his nose until a good portion of the head is gone, and the best part of his tail and fins have also disappeared; nor is he left undisturbed to perform his labor, as when he has nearly completed his bed, after a severe battle, another that is stronger may drive him away and take possession, and he is obliged to seek another place and build again. After the redd is prepared and the female is ripened, she moves up alongside where the male is standing guard, and they deposit together the eggs and milt, at the same time with a movement of their tails sweeping the gravel over them to protect them from the myriads of other fishes that

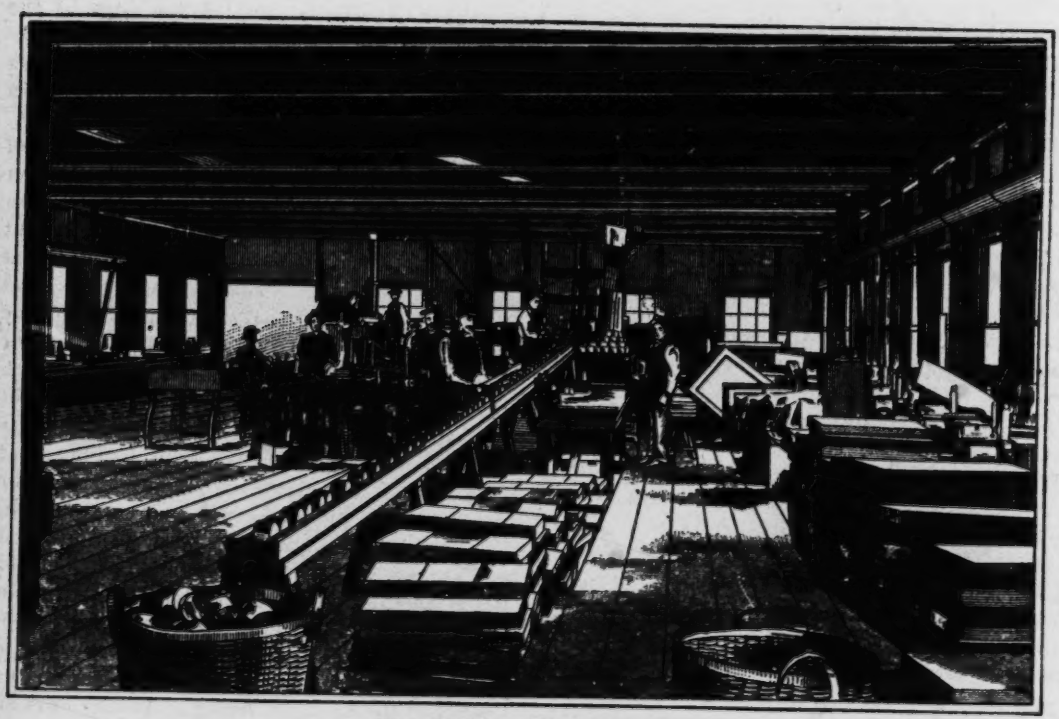
Cooking Department.

are lying in wait to gobble them up, and this they can perform with only a small degree of success, as the trout are so persistent that in spite of being fought away by the parent salmon they will return and lie so close as to seize the eggs almost as fast as dropped. After the work of propagation is completed they still remain on guard, fighting away any other fish which may go upon the spawning beds, until, worn out with their exertions they will float down the stream dead, with the exception that when a sudden freshet comes in the river some of the stronger ones may be swept down to the brackish water, where, although they arrive sick and sore, they take on new life, their sores are healed, and in four months they are as lively and plump as ever.

In verification of this proposition the writer will state that at his hatchery the adult fish, after spawning, have been marked and returned to the river, and four months later have been caught, and that they were in as fine condition as ever, beside having increased considerably in weight. I will also state that at the spawning time the male fish had the hooked nose and long teeth, which in some localities gain for them the name of Dog salmon and that when they were first put into the ripening ponds, and when taken the second time (the following spring) they showed no such peculiarity, the disfigurement being caused by the wasting process incident to the preparation for fecundation, and the fact that no food was taken in the meantime, causing a shrinkage of the flesh about the mouth, leaving the teeth exposed, and a contraction of the muscles of the face which draws the nose or beak into a hooked shape.

As we have now accompanied the lucky individuals back to the sea and noted the result, we will now take another trip to the spawning grounds, to see what has become of the object of their long and arduous struggle.

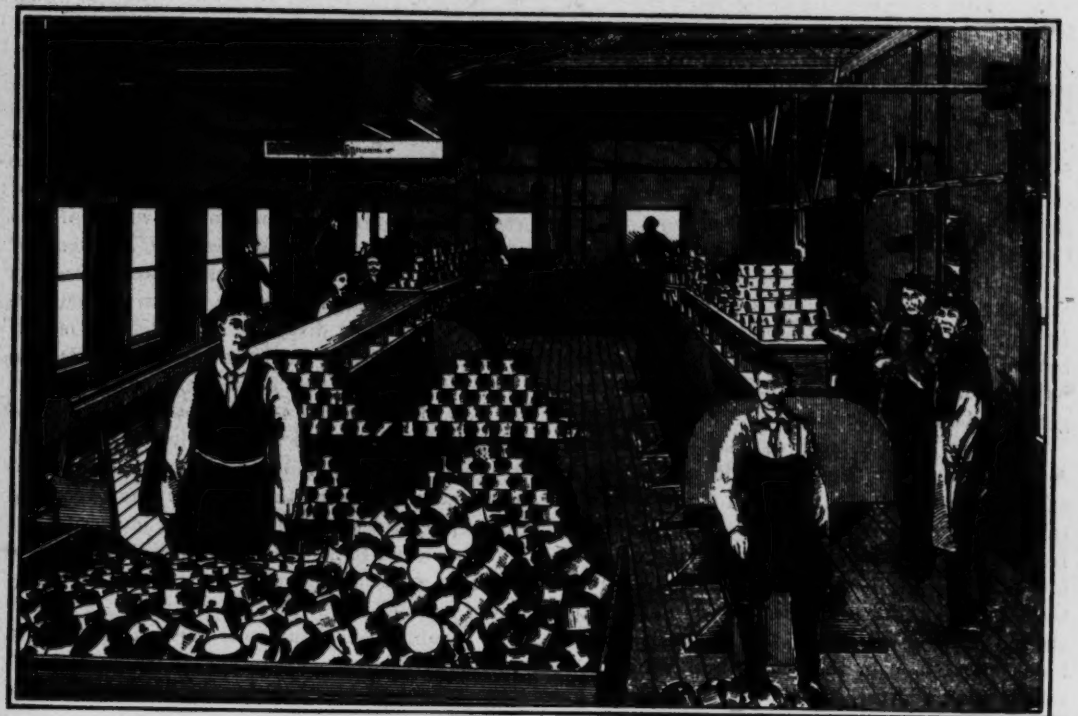
The eggs, after having been deposited in the gravel, if not disturbed by a heavy freshet, which often sweeps away all of them to destruction, lie secure from all enemies except those that can work into the recesses where they are hidden, for a period which depends upon the temperature of the water. The higher the temperature the more quickly they are hatched, but with the temperature forty-five to fifty degrees they will hatch in from forty to fifty days, while in Alaska, with the temperature at from twenty-six to thirty-five degrees, it has taken five months and a half



Can Making Department.

before they began to break the shell of the egg. After breaking the shell in which it was confined, and with the umbilical or yolk sack attached, it is a helpless little object, its only protection being its instinct to dive into the sheltering depths of the gravel, where it remains, without taking food, until the yolk sack is absorbed, at which time it ventures forth in its search for food, and at this time becomes the helpless prey of trout and many other enemies. Another source of destruction is a disposition on the part of the young fry to ascend every little branch or rivulet as far as they can get, and these little watercourses often drying up leave thousands of these little fish to die in its bed. Herons, king-fishers, cormorants, and birds of several other kinds gobble them up by hundreds, and it is almost surprising that any escape. It is estimated by good authorities that of the number of eggs deposited, and upon which different writers vary considerably, some placing the number as high as 12,000 for an adult female, not more than three per cent of which ever come to maturity in the natural process of hatching. While I have no doubt regarding the per cent that mature, I am satisfied that the number of eggs carried by the salmon have been much magnified, as I have repeatedly counted the eggs of the Chinook salmon at times when there was no possibility of any having been lost, and have always found exactly four thousand—two thousand in each roe.

About fourteen months from the time of hatching, a portion of the young salmon start on their journey to the sea, while the balance remain in fresh water another year, and many are caught by line fishermen under the mistaken idea that they are brook trout. Those that have descended the river on their way to the sea remain in the bay for a short time, and then are lost sight of for about four months, at the expiration of which time they return with such an increase in weight as to appear almost incredible, leaving the river when about seven inches in length, weighing but a few ounces, and returning weighing from four to five pounds, while a few reach a weight as high, even, as eight pounds. This, astonishing as it may appear, has been demonstrated at the Gold Beach hatchery, which is situated near Indian creek, to which the young salmon migrate when turned out of the hatchery, and from which a ditch is taken from the upper part to supply the hatching ponds with water. About fourteen

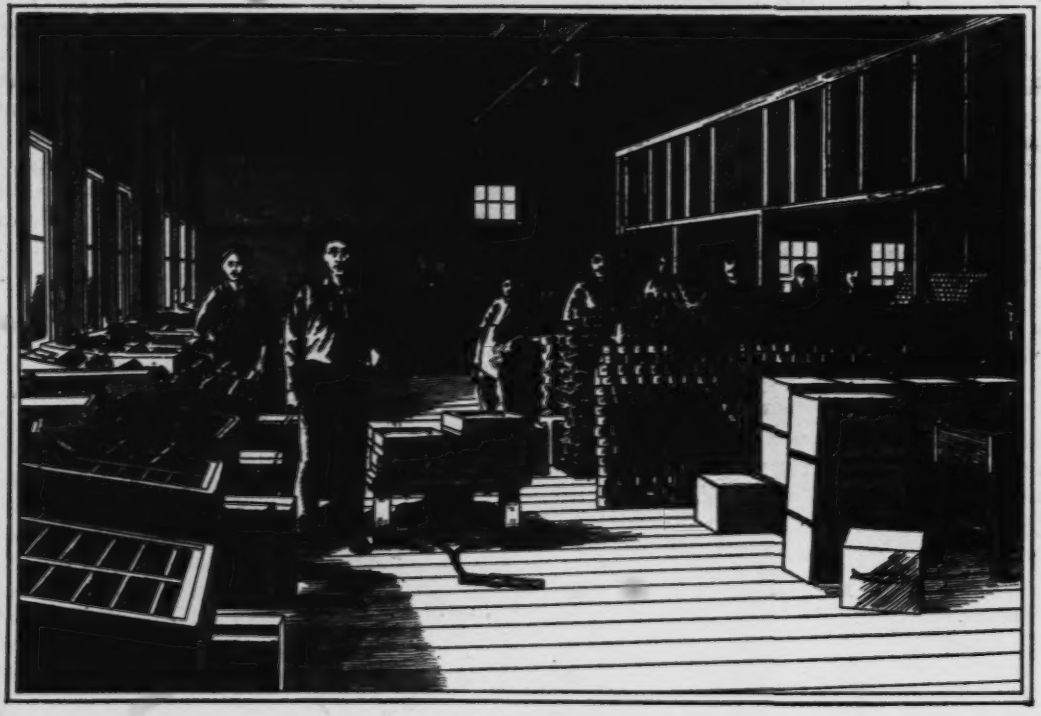


Can Filling and Sealing Room.

months after hatching, unless the ditch is shut off from the head on account of too much water, these young salmon come down the ditch and into the ponds from which they were turned the year before, and have been caught, marked, and turned out into the bay, where they were again taken four months later, with the result stated. Another peculiarity is that while the young salmon, on their first trip, remain but such a short time in the sea before ascending to the spawning grounds, the female does not show even a sign of spawn in the roe, while many young males will become fertile, and even the young males of the same hatching that have not yet made the trip to salt water, although but a few inches in length, will get into the same condition.

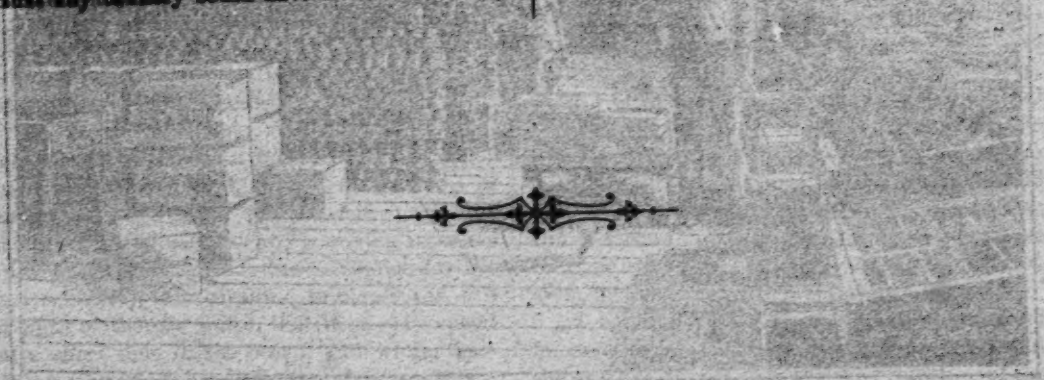
In view of these facts, at what other conclusion can we arrive than if adult salmon, which enter the river in April, deposit their spawn in the month of August, and remain until the freshets of November force any surviving members towards the sea, making due allowance for the time necessary for seasoning to stand the full strength of the sea water, that these fish spend but a short time in the ocean, and while there take on a wonderful growth, therefore would not be likely to journey far from the streams to which they are common, and would account for the fact that each river has salmon that are in some particular peculiar to itself. It would also appear that were those who claim that all salmon die after spawning correct, as well as those who claim that all young salmon that ascend the river do the same, it would necessarily follow that one trip of each class would be an end to the whole of this species that belong to that river. With many of the theories that have heretofore been generally accepted, both regarding the habits and culture of salmon, I must disagree, as the light of my experience has shown their fallacies; and it is also with astonishment that I hear persons at this day, in view of the success made in other branches of pisciculture, and with the knowledge of the destruction caused by the encroachments of civilization, making the assertions that all that is required to keep up the supply is to allow a portion of the run to ascend to the spawning grounds, that have been, or are in the process of being, destroyed by every method known to civilization.

I contend that without reasonable exertion for the erection and operation of hatcheries, and the exercise of wise laws for the protection of the



Packing Room.

spawning grounds, and regulating the size of fish to be taken, the States of Oregon and Washington, which now enjoy a monopoly of the finest quality of salmon in the world, will have soon lost their heritage. The lack of interest manifested by those engaged in the salmon canning business on the Columbia, in the matter of their propagation, is surprising, when very many are aware how simple and inexpensive is the process of merely hatching the eggs—in fact, so simple that any cannery could have a small hatchery, and by obtaining eggs in which the eye spots were formed could finish the process, and when the fish were well developed distribute them with little trouble in the fresh water branches nearest their location. They could also procure eggs, if by concerted action they would establish ripening ponds at the mouths of some of the small streams that put into the lower river, similar in character to those in use at Gold Beach, a description of which will be given in a future discussion of the subject.



4. The Art of Salmon Culture. The Apparatus Necessary for Propagation.

IN ORDER that any readers who may be stimulated by what is herein contained to undertake the propagation of salmon, may avoid the mistakes and difficulties which were made and encountered by the writer in his early attempts, and the very considerable expense consequent thereto, a short history of the early part of the undertaking may prove useful, as well as furnish some evidence to substantiate the conclusions to which I have arrived in former articles regarding other branches of the question. More than twenty years ago I suggested to the packers of the Columbia river that as other streams, which were formerly abundantly supplied, had at that time become pratically exhausted, something should be done toward stocking the river; but I was generally met, with the remark "that the salmon would last as long as they would need any." A few years, however, convinced them that they might be mistaken, and the result was the location of a hatchery on the Clackamas river in Oregon.

Hearing that salmon of a fine quality were very plentiful at the Rogue river, I purchased a location and built a cannery there the latter part of 1876, and in the spring of 1877, much to my surprise, packed only 3197 cases, which was all that could be obtained by the utmost exertion, which proved that the reports, except as to quality, were but echoes of the past; and thus I was furnished with the necessity as well as the opportunity to put into practice those crude ideas which had long been forming in my mind. As soon as I realized how few salmon the stream afforded, operations were begun towards stocking by excavating a pond for holding and ripening the adult fish, on a little spring branch which afforded about one thousand gallons per hour, during the dry season, that put into the river about a mile

from the bar or entrance, and a small hatching house was built close by the pond. After completing the pond and house I stocked the pond with one hundred adult female salmon and fifty of the male species of the finest specimens that could be selected. After this was accomplished I made a trip overland to the hatchery on the Mc Cloud river, a tributary of the Sacramento in California, for the purpose of observing the operation of spawning, etc., arriving there in the early part of August, and although the superintendent was away the men in charge kindly went through the operation for my benefit. After making note of the various items of interest I proceeded to San Francisco, where by the kindness of mutual friends I was introduced to the Hon. B. B. Redding, then secretary of the fish commission of the State of California, who proved to be very enthusiastic on the subject of salmon culture, and who, when I stated that I was in pursuit of information upon the subject, advised me to engage the services of a young gentleman by the name of Kirby B. Pratt, who had been employed at the McCloud hatchery for a number of seasons; and acting upon the suggestion I engaged Mr. Pratt, and we at once made our way to Rogue river, when Mr. Pratt took charge, and against all difficulties with which he had to contend, in spite of the fact that he had previously had no experience with fish that had been kept in retaining ponds for the purpose of ripening, from one hundred females, in the following spring succeeded in turning out three hundred and fifty thousand healthy salmon. After turning out the young fry, on account of poor health Mr. Pratt was compelled to seek a more genial climate, and thus we were deprived of a valuable assistant in our efforts.

Having made such a success in the beginning, the next season I determined to so prepare, that we should correct the weakness of our system of the year previous and make a much larger output, and with this in view made the pond larger, planked and tarred it, increased the water supply, cut away the timber that heretofore had shaded the place, and made quite a clearing, beside many other, as we thought, improvements about the place. When the season had arrived we placed a fine lot of salmon in the pond, but much to my surprise in a short time they began to swim about near the surface of the water, showing white patches in various parts of their bodies, which

kept growing worse until they were covered by a growth of fungus, their eyes blinded, and finally nearly all died, leaving only enough to give us about fifty thousand eggs. At this result of what I had considered would enable me to surpass any previous efforts, I was much disheartened, but finally concluded that the trouble came from the planking with which the pond had been enclosed, and that a liberal use of coal tar would correct that, and then everything would go along in good style. So the next year I tarred liberally, but on placing the fish in the pond the same thing occurred. By this time I was so much worked up over the question that I determined to make a radical change. I would no longer trust planked ponds, but build with stone, and as there was a point of solid ledge on the up-river side of the cannery I had the earth piped away from a portion of it down to the solid rock, and built a concrete wall around, enclosing a space forty by sixty feet, and turned in a much better water supply than ever before, believing that I had at last solved the question, and in my mind's eye seeing many young salmon ahead. You can imagine my disappointment and disgust when, after repeating the operation of the year before, the same result occurred. To add to my eagerness to succeed, the crop from the first year's planting came in that year, and for a time the river seemed alive with fish, while with all the force we could muster we were not able to take care of half that might have been caught.

The evidence of the value of propagation being so forcibly brought to my mind made me very anxious to succeed, and I would spend hours on the point above looking at the poor creatures paddling about the surface of the pond, and worry myself sick in the effort to discover a remedy. One day while occupied in this manner I began to reflect upon the proposition, and asked myself the question, under what conditions was the greatest success of this undertaking made? And the recitals of conditions came in this order: a little pond, a little water, a great deal of mud, and so much brush and trees that the place never got the sun. "Eureka!" I cried, *"I've got it!* That is what has been the trouble! I at once began the construction of a building over the pond that would close out the light, and when completed put in a new lot of salmon, with the result that they showed no signs of the previous trouble. When the building was closed the place became

so dark that the fish remained perfectly quiet, probably having the idea that they were in a deep pool, while previously they were bruising themselves badly in their attempts to find an outlet. If the letting in of the sunlight would produce such an effect upon the fish that were in a pond, the bottom and sides of which were constructed from solid ledge and concrete, with the water at a depth of ten feet, and fed by a pure stream, would it not seem reasonable that the removal of the timber and undergrowth at the headwaters of a stream would produce the same result? Would it not also indicate the origin of the so-called salmon disease which has afflicted these fish in the rivers of Great Britain?

Having shown some of the difficulties attending my first efforts towards propagation, before dealing further with that question I will briefly note some of my impressions regarding the work at the McCloud hatchery, which is mentioned in the early portion of this article. For several years this hatchery was maintained by the government of the United States, and from seven to twelve millions of eggs taken each year, that were distributed in almost every civilised country in the world, but with no apparent beneficial result, which to my mind has had the effect of discouraging in a great degree the government from extending any considerable aid to the salmon hatcheries of the Pacific Coast. That this experiment should prove a failure should cause no surprise when it is realised that the spring variety of the Chinook salmon, or *Salmo Quinnat*, which is common to only a limited area of our coast, and in but a few of our longest rivers, is a creature of conditions of such peculiarity as are found in no other rivers of the world, viz: rivers of great length, that take their rise in the everlasting snow and flow through a country of such temperate climate that ice is seen in them but occasionally, and then only for a very short time. I firmly believe that like conditions must be had in order to bring about like results, and that to transplant salmon successfully they must be placed in rivers where the natural conditions are similar to that from which they have been taken.

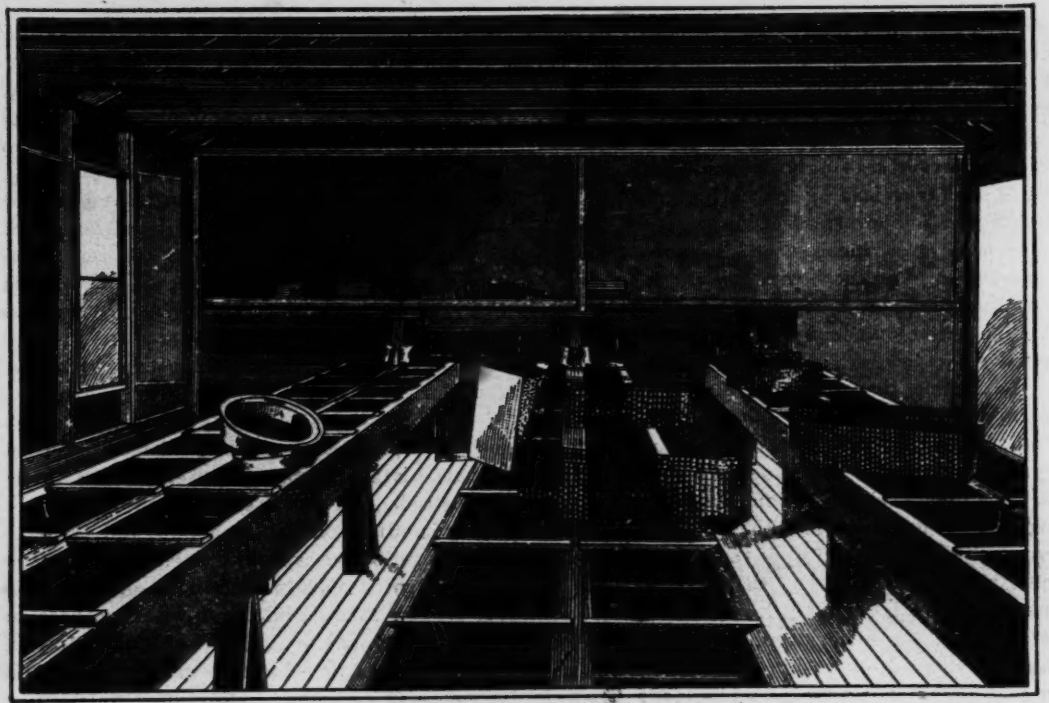
To begin a description of the process of propagating salmon artificially, the first to be noted is the ripening ponds, although if eggs can be obtained from fish at the natural spawning grounds these would not be necessary, although very useful as feeding ponds for small fish. At

Gold Beach we have two ripening ponds, about forty by sixty feet each, and ten feet in depth, one of which extends into the river to low water mark, which enables us at high water to come alongside with the racks or crates which contain the adult salmon and dip them into the pond without much trouble. The second pond is located upon the bank above, and first receives the water supply, which falls a distance of about thirty-five feet, and afterwards discharges through the waste way into the lower pond with a fall of about fifteen feet, which aerates the water sufficiently, so that two hundred miner's inches will keep five hundred ripening salmon, if divided equally in the two ponds, in good condition for the purpose of propagation. The pond nearest the river is built on a solid ledge bottom, with walls of concrete, while the upper is of concrete altogether, and each being separately covered by a low roofed building, arranged to shut out as much light as possible.

The hatchery building is eighteen by forty-eight feet, with the walls about eight feet in height, and is constructed in such a way that by closing the shutters it can be made quite dark inside. On the banks above the hatchery, and connected with the water main by a pipe through its bottom, is a tank for filtering the water which is used in the hatchery, which tank is twelve feet long, four feet wide and three feet deep, with a partition in the middle which extends from the bottom to within six inches of the top. In the space where the water first enters is a filter made of alternate layers of coarse gravel and charcoal, while in the next are three flannel screens in frames that slip into slides which set on an incline, so that the pressure of the water will hold them in place. The water, flowing up through the charcoal filter and over the partition, passes through the screens and is carried by a flume to another tank of the same size and kind, except that it has no charcoal filter. This is set across the end of the hatchery building, and has two outlets, six by twelve inches, one of which discharges into a distributing tank, fourteen feet long and eight inches deep by twelve inches wide, inside measurement, and the other into another distributing tank of the same size just below the first, each outlet having gates or slides to shut off from the filtering tank and divert the water from the upper to the lower tank, or the reverse, as desired, for the purpose of cleaning out any sediment that

might be deposited without stopping or interrupting the flow of water through the hatching tanks or troughs. These extend lengthwise of the building and join on in pairs to the lower distributing tanks, the end of the hatching trough having a partition which comes flush with the sides, and set on an angle to suit the incline of the trough, and butts up to a joint against the distributing tanks, which has a notch three inches long by one and a half inches deep cut in its side to match a corresponding notch in the end of the hatching trough, where it butts against it, for the purpose of letting the water flow into the hatching troughs. The extreme length of each set of hatching troughs is fifteen feet seven inches, and they are placed in a grade of three inches for their length. These are followed by another set placed in line on the same grade, which receive the water which passes through the first set. The troughs are nine inches deep and twelve inches wide, inside measurement, with partitions six inches high, to form a series of dams or riffles, and set in two feet six inches apart from centre to centre. About six inches from each end of the space enclosed by the partitions a rod of iron one-quarter inch in diameter passes through the trough about three-quarters of an inch above the inside of the bottom, for the purpose of forming a resting place for the hatching baskets, so that a space may be left between the basket and the bottom of the trough, so that as the young fish are hatched out they may work through the mesh in the bottom of the basket into this space. The object in making the troughs so much deeper than the partitions is to prevent the young salmon, after the sack is absorbed and they become lively, from jumping out, and that of placing the troughs in double lines is to save room and make a good passageway between the different lines of troughs, so they can be easily worked in picking out dead eggs. We have three double lines, two sets in length, with passages on all sides, and these have the capacity to turn out one million five hundred thousand fish, if worked to the fullest extent. After the water has passed through the hatching troughs it falls into a long flume, which forms the waste way which comes from the end of the distributing tank, where there is a gate to regulate the pressure of the water that passes into the hatching troughs, and the surplus runs into the waste way, and this discharges into a tank on the floor or scaffold in the ripening pond, a portion of which

(See cut page opposite.)

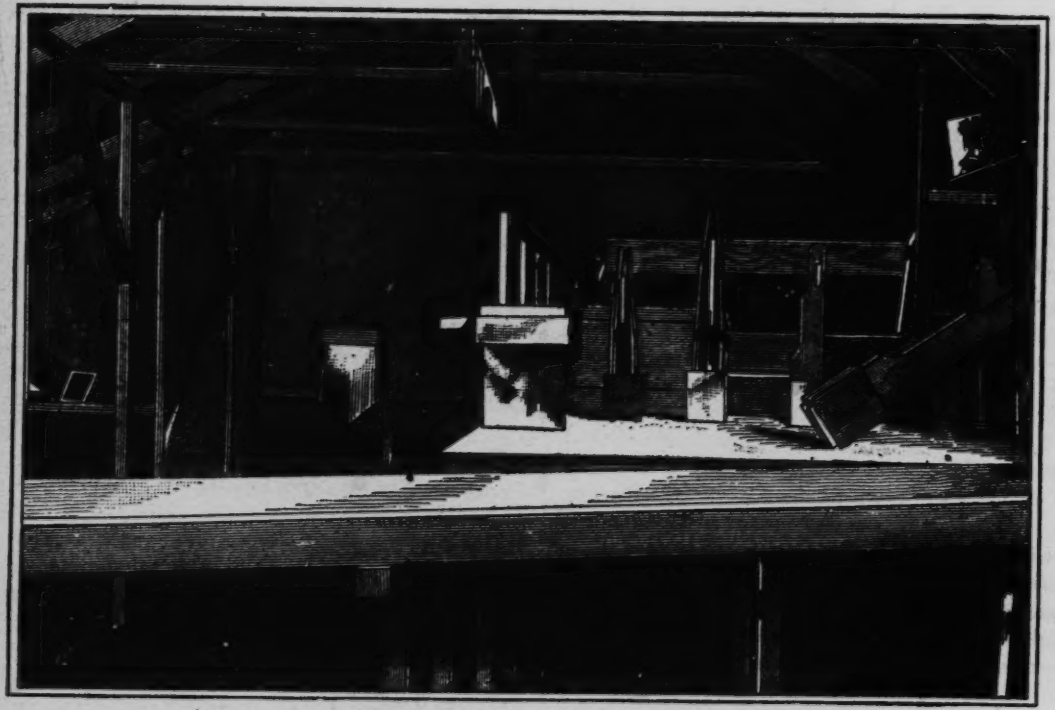


Interior of Hatchery, showing Pans, Distributing Cans, Hatching and Distributing Tanks, or Troughs.

is floored over on a level with the wall for the purpose of handling the fish when spawning. This tank is about six feet long by four wide and two feet deep, and discharges into the pond. All tanks, troughs and waterways are given a good coat of tar every season, both inside and out, as well as all flumes leading to filtering tanks. The hatching baskets are two feet long, ten and a half inches wide by six inches deep, the mesh of which is one-eighth of an inch wide by three quarters of an inch long, and an excellent one is made after the writer's model by A. S. Hallidie of San Francisco.

Next comes the tables (with their dumb clocks on the wall back of them) upon which to set a dozen six-quart pans which hold the impregnated eggs, one pan under each clock, which is set for the time that each operation has to be passed through, so that when the time has arrived which agrees with that marked by it the next manipulation takes place. Close by the table is a small sink or shallow tank about three feet long by two feet wide and six inches deep, and a tap to draw water as required for washing the eggs after impregnation. Next comes the midwives, which on account of their peculiar shape are difficult to describe. These are made of white cedar or spruce sides attached to a back piece that is hollowed out to fit the back of the fish, and the sides are cut away to leave the belly exposed, tapering from the tail end toward the head for about three-quarters of its length, the balance being left square. A head piece is made which fits over it, and can be telescoped back and forth to suit the length of the fish, and fits over his jaws, while the tail is held in place by a strap. This, although but a crude description of the apparatus, may serve as a hint to the beginner, who may, by the exercise of a little inventive ability, construct what he needs for the purpose. (See cut on opposite page.)

A couple of dip nets of fine twine and small mesh (the smaller the better), about three feet deep, and hung in a hoop of steel made of three-eighths rods, and two feet across, attached to a pole or handle about ten feet long, and three or four five gallon oil cans with the tops cut out and a piece of wood nailed across the inside of the top part to serve as a handle, and with a couple of holes cut on opposite sides, with some pieces of fine mesh wire web soldered over them to permit the escape of surplus water and prevent fish from getting out when water is added in transporting



Spawning Floor in Ripening Pond, with Midwives.

the young fish from the hatchery to adjacent streams, with the exception of a few brooms and buckets, completes the list of articles necessary for the purpose of salmon culture.

5. The Art of Salmon Culture. Propagating the Fish.

WHEN the spawning time arrives, the first to be done is to turn on the water through the filtering tanks into the hatching troughs, and put in place as many baskets as is considered necessary for the amount of eggs expected to be taken during the day. When all is in order and the tank that receives the waste is filled and overflowing, two of the operatives with the dip nets begin the search for ripe fish, and when one is secured they place it in the midwife, then put the midwife with the salmon in the waste tank, where it will keep alive and in good condition for a few hours. They then resume the search for another salmon of the opposite sex, and when they have secured one, place that also in a midwife. While one operator siezes the one in the waste tank and sets it on end with the vent of the fish down, the other does the same with the last one caught, while the third operative holds one of the pans under the vents of both fishes, which have been brought as near as possible to each other. The manipulators then gently press the bellies of the fish with a stroking motion, from the throats downward to the vents, to discharge the eggs and milt simultaneously into the pan; and at the same time the person holding the pan, with the end of his fingers resting on the bottom of the pan, in order not to jam the eggs, gently stirs the eggs and milt together. When the fish are well ripened this operation consumes but a couple of minutes, and it is very essential that the operator should be particular not to undertake to spawn unripe fish. It is very easy to select ones that are ripe, as in the female the eggs have been separated from the roe when ready for spawning, and when the fish is set on the end with the vent down, the eggs will settle toward it like shot to the bottom of a sack, which will cause a shrinkage of

the upper part toward the throat; while the male, when ripe, if handled will eject the milt with a spurt. After this operation is performed the pan is placed gently on the table and allowed to remain quietly from fifteen to twenty minutes, after which water is poured gently down the side of the pan until the eggs are covered to the depth of an inch or two. They then are allowed to remain in this condition for an hour, during which time the milt, which in the first operation has formed a curd, fastening all the eggs together, will have become separated.

The operator then takes the pan to the washing tank, which has been filled with water from the tap, and a constant stream kept passing through it, gently dips the pan into the water with a swinging motion floats the milt or curd over the edge of the pan, until the eggs are well cleaned from it. It will then be discovered that while the eggs when first taken were of a pinkish color, now that impregnation has taken place they have become the color and have the appearance of rich ripe currants. After the washing is done the operator takes the eggs to the basket which is in the hatching trough, and places the edge of the pan in the water close to the up-stream end of the basket, and with a gentle sifting motion toward the other end deposits the eggs. This may be repeated until the basket contains from sixteen to twenty thousand eggs, the smaller quantity being the better, as it provides for the spawn of four salmon, and gives better results in hatching, besides making more room for the young fish, as they hatch out and drop through the bottom of the basket into the space below, where, if too much crowded, they do not thrive so well.

After having placed the eggs in the hatching troughs the hatchery is kept darkened as much as possible, and they are allowed to remain without being disturbed in any manner until twenty-four days have elapsed, at which time they are examined and any dead eggs picked out. As this is a great departure from the rules laid down by many authorities, who insist on picking out the dead eggs as fast as they appear, I will say that my experience would tend to show this mode of operation to be wrong, as we formerly operated in that way and I have seen baskets of eggs that were properly impregnated destroyed by being picked over before the eye spots and yoke sack were fully formed, they dying faster than the operator could pick them out, although there seemed at the be-

ginning to be very few dead ones in the basket. Since adopting the plan of leaving the eggs undisturbed until the twenty-fourth day after spawning, our losses have been less than one and one-half per cent, which is a better result than I believe can be shown by any other method of operation.

Another departure from the old style of hatching trough that we have made, is that instead of having a double set of partitions, the water passing over one and under the other, causing a boiling or eddy in the section where the baskets are placed, we use only one, the surface of the water passing over the eggs with a natural riffle, they lying undisturbed below, while the water does not deposit so much sediment as in the old style trough, besides allowing the use of a greater volume of water. While in full operation our hatchery is using in the first stage of development about sixty gallons of water per minute. After the twenty-fourth day the flow of water may be increased to seventy-five gallons per minute with good results. While the eye spots are to be seen in from eighteen to twenty days, the membrane which forms the yolk sack does not become firm enough to permit handling the eggs with safety until past the twenty-third day, while after the thirtieth day, by being kept cool and moist, and being packed in wet moss, they may be kept for several days and transported hundreds of miles, and when again placed in the hatching troughs will go on with the process of hatching. Sometimes in picking over the eggs to remove the dead ones, some that were good have accidentally fallen on the damp floor of the hatchery and lain for several days; when picked up, and again put in the basket have hatched out as well as any. The appearance of the eye spots, as well as the hatching of the fish, depends on the temperature of the water, the time mentioned above being with the water at a temperature of forty-five degrees, and the beginner will be governed by any variations of temperature, but must not disturb the eggs until four days after he has discovered the eye spots, which will appear as two little black specks close together on one side of the egg.

After the dead eggs have been removed which will be easily destinguished on account of their having turned white, all that need to be done, is to keep the water passing with regularity through the hatching troughs, keeping the light shut out of the hatchery, and look at the eggs

once every two or three days, picking out any that may have been injured in the first operation of picking. When the eggs begin hatching and the young fish commence to work through the bottom of the basket, it is well once a day to gently tilt the basket, first at one end and then the other, to allow them to work down through the unhatched eggs into the space below. When the eggs begin hatching, place fine mesh screens on the outlet of the waste tank, so any of the young fish that may be carried by the current over the partitions may not be lost. After all in the basket are hatched, which will sometimes take several days from the time they begin breaking the shell, let them remain undisturbed in the hatching troughs, and in about thirty-five days, with the water at forty-five degrees, the yolk sack will have become absorbed, and they are ready to take feed, which must be given sparingly and pulverized finely. After being fed a week or longer, according to the quantity on hand and supply of food to be conveniently had, they are ready, if desired, for distributing, which is done by shutting off the water flowing through one line of troughs at a time, and placing one of the five-gallon cans mentioned under a vent in the bottom of a section where the baskets rested, then by withdrawing a plug which is driven in the vent from the under side of the hatching trough, draw the water and young fish into the can, which will safely transport twenty to thiry thousand young fish, with proper management, although if any distance is to be made, a less number is easier to manage. After as many as are required for the day's planting have been drawn off, the water is again turned through the hatching trough, the cans are placed in a skiff, the best sort having a platform in the stern, with a bulkhead to keep the water out of the body of the skiff and permit the overflow from the cans to pass overboard. If the river is fresh, the person having the fish in charge keeps dipping the water from the stream and pouring it into the cans, and if salt, the can must be set in large tub of water, which can be dipped from, poured into the cans, the tub receiving the overflow, the water being aerated by letting it fall in small quantities at a time from a height of one or two feet. Arriving at the mouth of some fresh water stream the young fish are turned out above the action of salt water, when they at once begin their journey up the stream and our labor is over. It has been the practice at the Gold Beach

hatchery to turn out but a portion of the hatching in the manner above mentioned, while of the remaining portion the larger part are kept in the hatchery until the spring run of salmon begins, and in the meantime are fed upon canned salmon taken from what are called do-over cans, that have been left from the year before. When the cannery starts in the spring we turn out the young fish, which, as the water in the bay is perfectly fresh at that time of the year, remain near the cannery wharf and feed from the waste which is thrown out after canning their relatives. As soon, however, as the river gets low and the brackish water begins to encroach upon them they move off up the river and into the adjacent tributaries. The young fish remaining in the hatchery are turned into the ripening pond and are fed with the immature eggs taken from the salmon while canning, upon which they thrive wonderfully, growing in the same length of time to four times the size of the young of the same hatching that were turned into the tributaries, and become so fat and plump that they are nearly equal in measurement in all directions. When they are four or five inches in length, by taking a sharp razor a person who is of delicate touch can cut off the dormant fin, which is located on the back nearest the tail, in that way making them so that they may be easily recognized when caught after returning from the sea, which has been done at the Gold Beach hatchery. The same process as is herein decribed for the propagation of salmon will also apply to the culture of trout, if the appliances are reduced in proportion to the size of the fish and operated in the season when their natural spawning time comes. The product can be kept in retaining ponds of like character, and when grown taken as required.

In this brief treatise on the art of salmon culture, it has been my endeavor to place before the reader, a plain and simple statement of those methods which in my experience have been found most practical and producing the best results, without such a complication of description as to befog the mind of, and render the work of no practical use to, the beginner in the art of pisciculture, but rather a safe guide to any who may desire to engage in the undertaking for their own benefit, as well as that of the community in which they are situated. While the writer does not lay claim to having accomplished any great results compared to what might have been easily possible, a recital of the

adverse conditions under which the work has been carried forward will enable the reader to understand under what difficulties we have labored. One of our greatest troubles was the water supply, which at its best is limited to a small quantity, and in the time it is most required nearly drying up. The Gold Beach hatchery is also located within three-fourths of a mile of the ocean, hundreds of miles below the natural spawning beds of the earliest spring Chinook salmon, which adds greatly to our difficulties, as when the salmon have just entered from the sea they are very delicate, not bearing any rough handling, besides retaining in ponds for such a length of time as is required for them to ripen, calls for constant watchfulness in order to keep up a steady water supply. To this is added the difficulty of obtaining the adult salmon alive to put in the ponds, as the fishing on the river is done entirely by gill nets. The fish taken by them cannot be used, as when the mesh of the net gets into the gills the fish are sure to die; and in order to get fish for the ripening ponds we have to use seines and float the fish in crates for several miles, besides handling them several times when they are the least able to endure such treatment. It would seem that in view of the simplicity of the methods and certainty of success of salmon cultivation, good evidence of which is shown by the operations of our neighbor in the Dominion of Canada, who in 1887 had established nine salmon hatcheries, by which they have kept up the supply in the various sections of their country, together with the showing made by the writer, whose work has increased the supply of spring salmon in Rogue river nearly four fold, in spite of very adverse circumstances, the record showing that it is the only river in the world where fishing has been done steadily each season that has shown such an increase, while the fall run in the same river, which has not been propagated, has fallen off in as great a proportion, should satisfy any reasonable mind as to the value of salmon culture, and stimulate not only those engaged in the business of canning, but the State and general government, to assist and encourage in every way possible the cultivation of this excellent fish. If the writer, by the feeble efforts which appear in any of the preceding pages, is able to awaken any to the importance of, and necessity for speedy action, he will have been amply repaid for his exertion.

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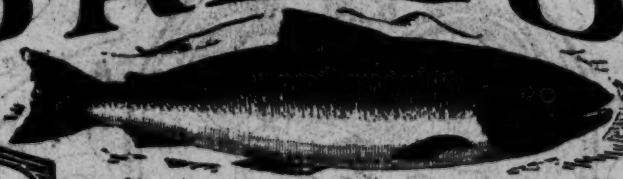

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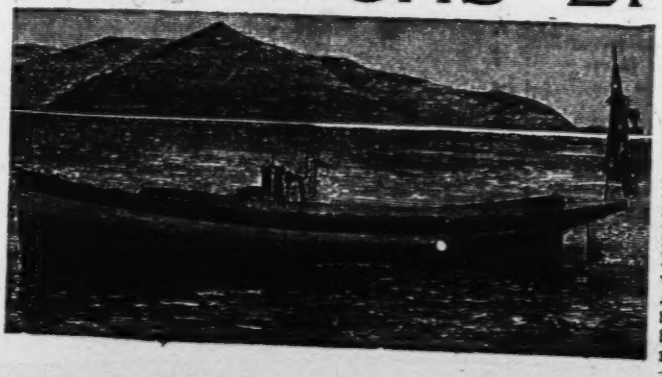

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